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TEST DEVICE FOR LED MATRIX DISPLAY
[LED Matorikusu Disupurei Shiken Sochi]

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Specifications

/347[1]

1. Title of the Invention

TEST DEVICE FOR LED MATRIX DISPLAY

2. Claim(s)

In the performance of tests on the optical and electrical characteristics of an LED matrix display wherein LED pellets have been arranged at intersections of rows and columns, a test device for an LED matrix display which is equipped with an X-axis drive control and a Y-axis drive control which generate position control signals corresponding to the position of an LED pellet to be tested, an optical sensor provided to freely move along a surface opposing the above-mentioned LED matrix display, an optical sensor drive section provided with the above-mentioned position control signals to drive the above-mentioned optical sensor, an optical characteristics measurement section which measures the optical characteristics of the facing LED pellet according to the output of the above-mentioned optical sensor, relay groups used for selecting the LED pellet that faces the above-mentioned optical sensor according to the above-mentioned position control signals, an electrical characteristics measurement section which measures the electrical characteristics of the LED pellet chosen by these relay groups, and a display section which displays the measurement results of the optical and electrical characteristics measurement sections.

3. Detailed Specifications

(Technical Field of the Invention)

The present invention relates to a test device for an LED matrix

[1]Number in the margin indicates pagination in the foreign text.

display for testing the optical and electrical characteristics of matrix displays using LEDs (light-emitting diodes).

(Technical Background of the Invention)

A matrix display which has LEDs arranged like a matrix to perform a display by selectively lighting these LEDs has been known in the past. When evaluation tests are performed on such a matrix device that is large in size, such as a digital display device, it is lighted as a positional light source, in consideration the outer dimensions, in a dark room or the like to measure the optical intensity characteristics from a distance. It also takes time to measure the mass productivity in a test performed in a dark room, while the equipment become large in scale. Thus, the optical characteristics are subjected to a visual inspection, while the electrical characteristics are measured as direct current characteristics using a direct current characteristics parameter test device. /348

(Problems of the Background Art)

There were individual differences, however, in the optical characteristics with such tests, depending on the operator. In addition, it was difficult to digitize the results. Meanwhile, in a test of the electrical characteristics, the measurements are printed and data processing can be performed with ease. Thus, problems in mass productivity testing occurred because the test results for the optical and electric characteristics could not be summarized, making automation of testing difficult.

(Object of the Invention)

It is an object of the present invention accomplished in view of

the above-mentioned circumstances to provide a test device for an LED matrix display wherein the results upon measuring the optical and electrical characteristics of an LED matrix display are digitized, and the resulting respective measurement data are output, and automation of the tests can be engineered, so testing of mass-produced products can be performed efficiently.

(Summary of the Invention)

That is, the present invention is characterized by providing an optical sensor placed opposite the display face of an LED matrix display, moving this optical sensor in the X and Y directions, making it face each LED pellet, and simultaneously and continuously measuring the optical and electrical characteristics.

(Practical Examples of the Invention)

A practical example of the present invention will now be described in detail with reference to Figs. 1 to 4. Figure 1 is a drawing of the electrical circuit at the time of testing of an LED matrix display. It is shown that this matrix has **M** number of rows and **N** number of columns. For example, **M** and **N** are 64 and 32, respectively. **D**, **U** and **T** in the drawing are LED matrix displays to be tested. Sixty-four 64 rows $\mathbf{C_1}$, $\mathbf{C_2}$ ... $\mathbf{C_{64}}$ and thirty-two 32 columns $\mathbf{l_1}$, $\mathbf{l_2}$ and $\mathbf{l_{32}}$, provided at a right angle to these rows, are disposed, and respective LED pellets are connected to each intersection thereof. External leading-out terminals of the respective rows $\mathbf{C_1}$, $\mathbf{C_2}$ ... $\mathbf{C_{64}}$ are connected to the input terminals of a measurement section **MS** via rows $\mathbf{x_1}$, $\mathbf{x_2}$ ... $\mathbf{x_{64}}$. In addition, external leading-out terminals of the respective columns $\mathbf{l_1}$, $\mathbf{l_2}$ and $\mathbf{l_{32}}$ are connected

to the input terminals of the measurement section **MS** via relays y_1, y_2 and y_{32}.

Figure 2 is a drawing of the test mechanism for the optical characteristics of the LED matrix display. An optical sensor **Op** comprising solar cells, hot diodes, and the like are arranged in a direction relative to the display faces of the LED matrix displays **D**, **U** and **T**. The optical sensor **Op** is moved by an X-motor **Mx** and a Y-motor **My** arbitrarily along the face opposite the LED matrix displays **D**, **U** and **T**, so that it can face any of the LED pellets composing the LED matrix displays **D**, **U** and **T**. Moreover, the number of disconnections caused by fatigue of the wires during movement is lessened if two 2 output terminals are disposed by using a solar cell, hot diode, or the like as the optical sensor **Op**. In addition, even if the wires wear out, there is a merit for being able to discover the site of wear with ease.

Figure 3 is a block diagram showing the control section for performing the electrical and optical characteristics tests. **1** in the drawing is an optical characteristics measurement section which comprises the optical sensor **Op** to detect an electric signal corresponding to the measurement. **2** is an electrical characteristics measurement section which measures the diode characteristics of the LED, like the forward current I_F, forward voltage V_F, reverse current I_R and reverse current V_R and outputs the electric signals corresponding to the measurements. The measurement results outputted from the optical characteristics measurement section **1** and the

electrical characteristics measurement section **2** are given to a comparison section **3**, where they are compared with a preset reference value to judge the acceptance/rejection of the concerned measurement. The judgment results **f** of the comparison section **3** are provided to a storage section **4** where they are stored.

In addition, **5** and **6** are X-axis and Y-axis drive controls which output positional control signals $\mathbf{D_x}$ and $\mathbf{D_y}$ corresponding to the position of the LED pellet being tested. These positional control signals $\mathbf{D_x}$ and $\mathbf{D_y}$ are given to an optical sensor drive section **7** and respective X,Y sequence controls **8** and **9**. The above-mentioned optical sensor drive section **7** drives the optical sensor **Op** to the position corresponding to the above-mentioned positional control signals $\mathbf{D_x}$ and $\mathbf{D_y}$. That is, an X-motor **7b** is driven by the positional control signal $\mathbf{D_x}$ via an X-motor driver **7a** to drive the optical sensor **Op** in the x direction. Similarly, a Y-motor **7d** is driven by a position control signal **Dg** via a Y-motor driver **7c** to drive the optical sensor **Op** in the y direction. Moreover, a /349
positional signal **Xi** outputted from an X-sequence control **8** is given to the storage section **4** where it is stored, and the relays of the corresponding rows are closed off from the X-relay group **11** via a row relay driver **10**. Similarly, a positional signal **Yj** outputted from a Y-sequence control **9** is given to the storage section **4** where it is stored, and the relays of the corresponding rows are closed off from the Y-relay group **13** via a column relay driver **12**.

The LED pellet selected by the above-mentioned optical sensor drive

section **7** and the LED pellet selected by the row and column relay drivers **10** and **12** are controlled in a coinciding manner.

The judgment results **f** put into the storage section **4** are displayed on a display section **14** at the position corresponding to the positional signals **Xi** and **Yj**.

According to such a configuration, electrical connections to the respective rows $\mathbf{C_1}$, $\mathbf{C_2}$ ... $\mathbf{C_{64}}$ and the columns $\mathbf{l_1}$, $\mathbf{l_2}$ and $\mathbf{l_{32}}$ are made by inserting, e.g., the external leading-out terminals of the LED matrix display. Testing is begun by conducting a "start test" in Step 1 and performing an "align the sensor with the starting pellet position" in Step 2 in accordance with the flowchart shown in Figure 4. It is desirable to choose this starting pellet position so that it can be set properly, e.g., reduce the movement time and frequency. The X-relay group **11** and the Y-relay group **13** are selectively driven to the LED pellet faced by the optical sensor **Op** to form a circuit in the electrical characteristics measurement section. In Step 3, "test optical and electrical characteristics" is performed. The items for testing in the optical characteristics test include the light intensity $\mathbf{I_V}$ (brightness), while the items for testing in the electrical characteristics test include the forward current $\mathbf{I_F}$, forward voltage $\mathbf{V_F}$, reverse current $\mathbf{I_R}$, reverse current $\mathbf{V_R}$, etc. Moreover, the LED emits light during measurement of the forward current $\mathbf{I_F}$, so that the measurement of the light intensity $\mathbf{I_V}$ can be performed concurrently to shorten the test time. Acceptance/rejection is judged by comparing the measurements obtained in the respective tests with a

reference value in the comparison section **3**. In Step 4, "store test result" is performed in the storage section **4**. In Step 5, the optical sensor **Op** is made to face the next LED pellet by performing "move optical sensor," and also, the relays of the X-relay group **11** and Y-relay group **13** corresponding to the concerned LED are closed to form an electrical circuit. A judgment of "last pellet (end)?" is performed in Step 6. If the judgment is YES, Step 7 is executed, and if the judgment is NO, we return to step 3 where the test is performed again.

In Step 7, "return to the optical sensor starting point" is performed and in Step 8, "end test" is performed. By displaying the stored contents in the storage section **4**, for example, so-called map data, accept/reject of each pellet in a form similar to that of the LED matrix displays **D**, **U** and **T** in the display section **14**, the tests can be formed efficiently.

Consequently, it is possible to perform the tests automatically, and there is no dispersion caused by the operator's vision, so that precise and objective tests may be performed. In addition, since map data related to the characteristics of the LED matrix displays **D**, **U** and **T** is obtained, this data can be stored in an external storage file, such as a floppy disk. As a consequence, when a step for removing a defective LED pellet from the LED matrix displays **D**, **U** and **T** and replacing it with a non-defective one is provided, the manufacturing process can be streamlined remarkably by using the data stored on the above-mentioned floppy disk in this step. In particular, since the cost of an LED pellet of the LED matrix display is more expensive than a typical integrated circuit or the like, by replacing a defective LED pellet with a non-defective one after performing a test

in a previous step in which a resin cover and resin mold have been applied to the front, for example, generation of defective product can be reduced in the end, and an expensive LED pellet can be used effectively.

In addition, the present invention is not limited to the practical examples above. For example, the control section can be composed as in the block diagram shown in Fig. 5. That is, the measurement results of an optical characteristics measurement section **1** are given to a measurement storage section **15**. These stored contents are subjected to an arithmetic computation in an arithmetic logical unit **16** to obtain a ratio of the /350 light intensity of each LED pellet, which can be compared with a reference value in the comparison section **3**. Moreover, the arithmetic operation of the measurements naturally may be conducted on the measurement results in the electrical characteristics measurement section **2**.

Also, although the LED pellet being tested by using the relay group **11** and **13** was selected in the above-mentioned practical example, a semiconductor switch or the like having a similar function can be used.

(Advantages of the Invention)

According to the present invention in light of the foregoing, a test device for an LED matrix display wherein the results upon measuring the optical and electrical characteristics of an LED matrix display can be digitized and displayed, the test process can be automated to perform precise testing, and generation of defective product can be reduced remarkably.

4. Brief Description of the Drawings

Figures 1 to 4 show a practical example of the present invention.

Figure 1 is a drawing of the electrical circuit; Figure 2 is a drawing of the test mechanism for the optical characteristics of the LED matrix display; Figure 3 is a block diagram of the control section for performing the electrical and optical characteristics tests; Figure 4 is a flowchart describing the operation during testing; and Figure 5 is a block diagram of the control part of another practical example of the present invention.

D,U,T: LED matrix displays; Op: optical sensor; 1: optical characteristics measurement section; 2: electrical characteristics measurement section; 3: comparison section; 4: storage section; 5: X-axis drive control; 6: Y-axis drive control; 7: optical sensor drive section; 11, 13: relay groups

Figure 1

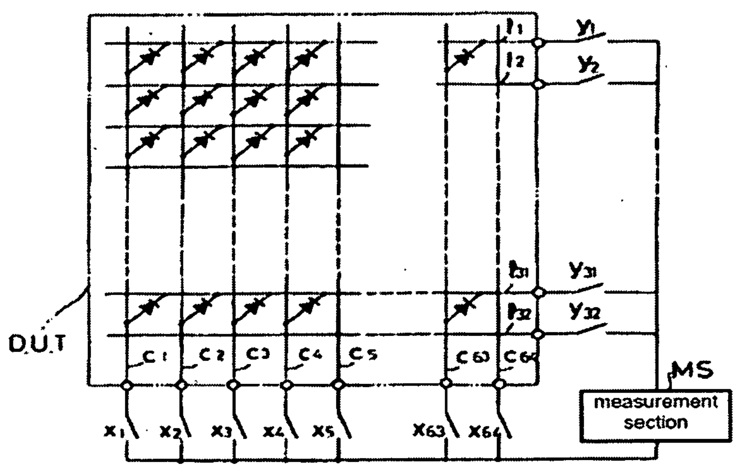


Figure 2

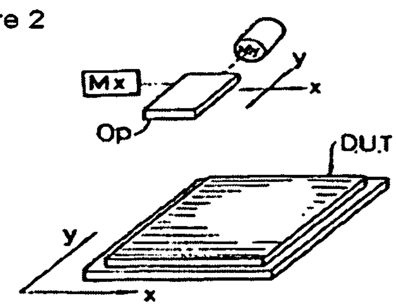


Figure 3

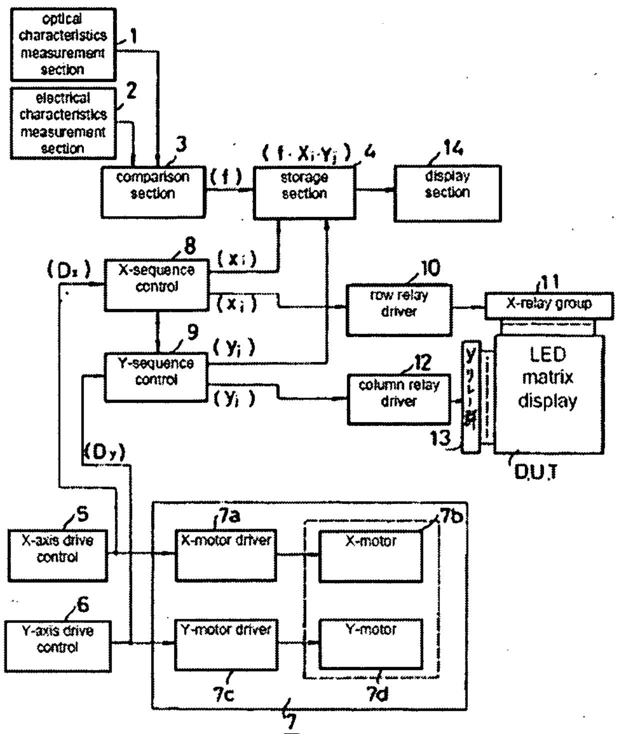


Figure 4

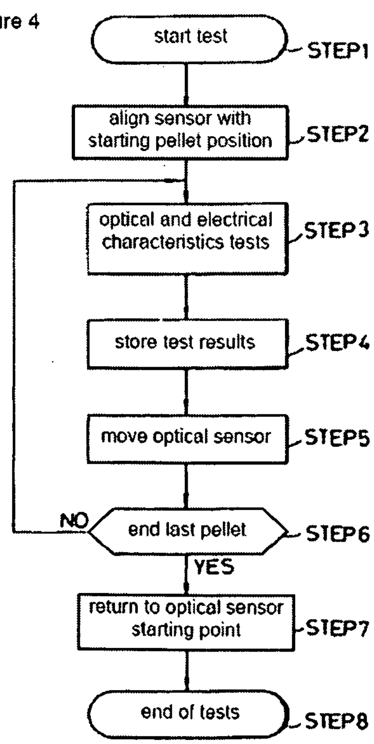
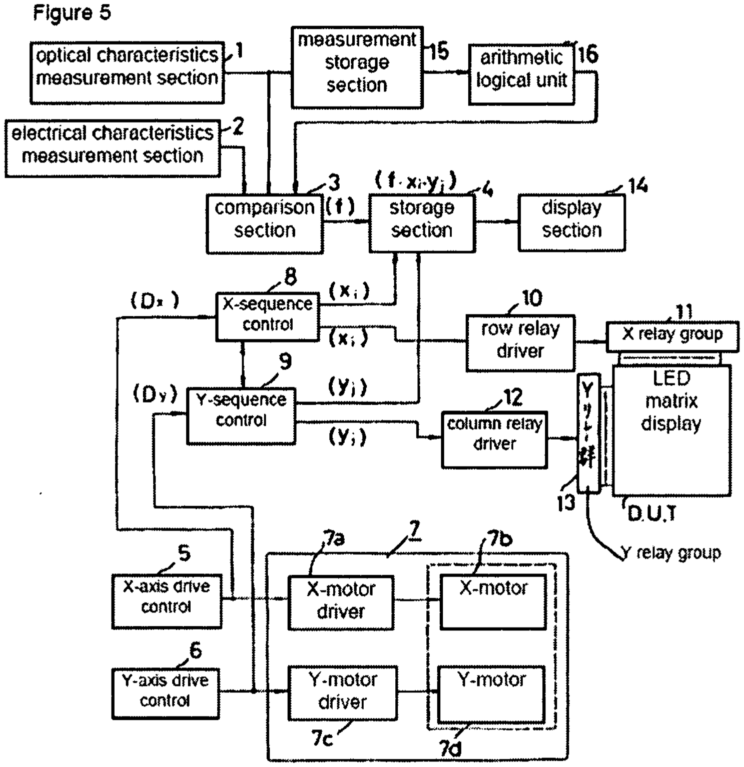


Figure 5


optical characteristics measurement section
1
measurement storage section
15
arithmetic logical unit
16
electrical characteristics measurement section
2
3
(f·xi·yj)
4
14
comparison section
(f)
storage section
display section
8
(Dx)
X-sequence control
(xi)
(xi)
10
row relay driver
11
X relay group
9
LED matrix display
(Dy)
Y-sequence control
(yj)
12
column relay driver
(yj)
13
D.U.T
Y relay group
7a
7
7b
5
X-axis drive control
X-motor driver
X-motor
6
Y-axis drive control
Y-motor driver
Y-motor
7c
7d